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EUROPEAN PATENT APPLICATION

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(21) Application number: 96307311.9

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(84) Designated Contracting States:
DE ES FR GB IT

(72) Inventor: McCann, Michael Owen
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(30) Priority: 31.10.1995 GB 9522249

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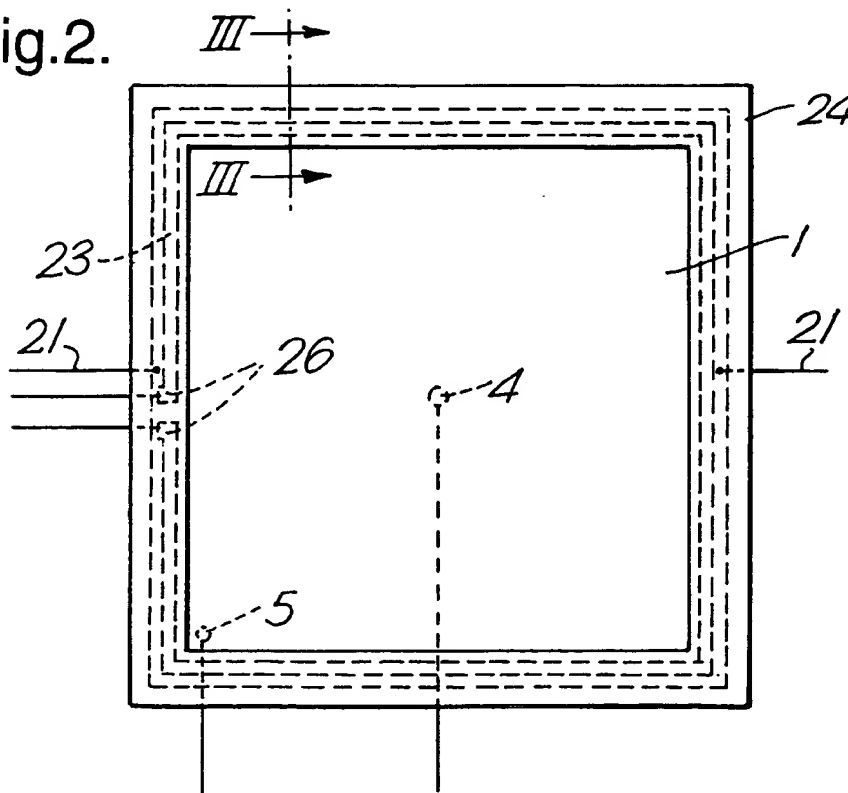
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London, NW11 8DS (GB)

(54) Display assemblies

(57) A transparent LCD back-lit display 1 has a transparent indium-tin oxide heater layer 20 extending across the display and a resistive metal strip 23, supported in a frame 24 of low thermal conductivity, extending around its edge. One temperature sensor 4 is mount-

ed at the centre of the display and another 5 is mounted at the edge. The sensors 4 and 5 are connected to a heater control unit 22, which controls power supplied to the heater layer 20 and the edge strip 23 to maintain the temperatures at the centre and edge of the display equal.

Fig.2.



EP 0 772 068 A1

Description

This invention relates to display assemblies of the kind comprising a flat panel display and a heater..

Some forms of display, such as liquid crystal displays (LCDs), only operate correctly at temperatures above normal ambient temperature. This is a particular problem with more complex, high performance LCDs having a large number of grey scales. Typically, a sixty-four grey scale LCD should be at a temperature between 40°C and 75°C to operate correctly. Currently, high performance LCDs usually incorporate a film of indium tin oxide, to provide heating, especially during start-up when heat from the display backlight will not have built up sufficiently.

The problem with these thin-film heating elements is that the heating effect at the centre of the display is greater than towards the edges. This problem is aggravated by the fact that the display is retained by a support around the edges, which acts as a heat sink for the thermal energy produced by the heater. The difference in temperature between the centre of the display and the edge during start-up conditions can be as much as 40°C or 70°C when starting from very low temperatures. Where the display is used in a critical application, such as in an aircraft, it can be important to raise its temperature to the correct operating value within a very short period; this can be as little as 30 seconds or less. Although it may be possible to achieve sufficient warming in the centre of the display within the desired time, the edge of the display may remain below the correct temperature for longer than desired. Furthermore, because the edge needs to be raised to the correct operating temperature, this means that the centre of the display is often heated to a greater temperature than is necessary. This can lead to delamination of the display over a prolonged period.

It is an object of the present invention to provide a display assembly that can be used to overcome the above-mentioned problems.

According to the present invention there is provided a display assembly of the above-specified kind, characterised in that the heater comprises a planar heating element extending across the display and an edge heater extending around the edge of the display.

In this way, it is possible to achieve a more even heating across the display.

The planar heating element is preferably of a transparent resistive material, such as indium-tin oxide. The edge heater may include a resistive metal strip electrically insulated from the planar heating element. The edge heater is preferably mounted in a frame of a material having a low thermal conductivity. The flat panel display may be an LCD display. The assembly may include a first temperature sensor mounted to monitor the temperature towards the centre of the display and a second temperature sensor mounted to monitor the temperature towards the edge of the display. The outputs

of the first and second sensors are preferably connected to a heater control unit, the heater control unit controlling the power supplied to the planar heating element and the edge heater such as to maintain the temperatures of the centre and edge of the display substantially equal. The outputs of the first and second temperature sensors may be connected to a display driver unit, the display driver unit controlling the power supplied to the display according to display temperature. The assembly may supply power to the heater when the assembly is first switched on and supply power sufficient to cause heating only while the flat panel display is below its operating temperature.

A display assembly according to the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of the assembly;

Figure 2 is an elevation view of the front of the assembly; and

Figure 3 is a sectional side elevation of a part of the assembly along the line III - III of Figure 2.

The display assembly comprises an LCD display 1, a display heater indicated generally by the numeral 2 and a backlight 3 for illuminating the display from the rear.

The display 1 is a conventional matrix array LCD panel, typically of square shape with sides about 10cm long, and having a high performance with a sixty-four grey scale. The display 1 is driven by conventional graphics and address/multiplexing electronics, not shown.

The heater 2 comprises two elements. One element is a transparent layer 20 of an electrically-resistive material, such as indium-tin oxide, coated on the rear surface of the display panel 1. The transparent layer 20 is contacted at opposite edges by wires 21 by which current is supplied to the layer from a heater driver unit 22. The other element of the heater 2 is an edge heater 23 incorporated into a mounting frame 24 for the display. The frame 24 has a rebate 25 into which the edge of the display 1 is received and is preferably of a material with a low thermal conductivity such as glass-reinforced plastics. The edge heater 23 takes the form of a resistive metal strip extending as a track along the four sides of the frame and having electrical terminals 26 at each end by which the heater is connected to the driver unit 22. The heater 23 has an electrically-insulative coating (not shown) and bears against the rear side of the display panel 1.

Two small temperature sensors 4 and 5 are attached to the rear surface of the display 1 to monitor the temperature of the display at its centre and close to its edge respectively.

The outputs from the sensors 4 and 5 are connected

to the heater driver 22, to control heating of the display, and to the display electronics (not shown).

When the display is started from cold, the heater driver 22 supplies power for both the thin-film layer 20 and the edge heater 23. Typically, about one quarter of the total heating load is supplied to the edge heater 23. In this way, the edge heater 23 increases the heating effect towards the edge of the display to compensate for the reduction in heating that would be produced away from the centre by the layer 20 alone. This produces substantially even heating across the entire viewing area.

The outputs from the temperature sensors 4 and 5 enable the heater driver 22 to vary the proportion of power supplied to the layer 20 and to the edge heater 23 if the relative temperatures of the centre and edges should vary. The outputs of the temperature sensors 4 and 5 are also used by the display driver to vary the power supplied to the display according to display temperature.

After prolonged use, the heating effect produced by the backlight 3 may be sufficient to maintain the display 1 at its operating temperature so that it is no longer necessary to supply power sufficient to cause heating to one or both heater elements 20 or 23.

Because the mechanical support for the edge of the display is provided by a thermally insulative member 24, the differential heating across the surface of the display 1 is reduced, even without the effect of the edge heater 23.

The present invention enables a greater proportion of the display area to achieve its optimum operating temperature more rapidly than has previously been possible, so that the quality of the display image is not degraded towards the edges. This is important in critical applications, such as in aircraft displays. The invention also avoids the need to apply excessive heating to the centre of the display in order to achieve correct temperature at the edges, thereby reducing the risk of damage to the display.

It will be appreciated that the edge heater could be of various different kinds and need not be a metal strip, as described.

Claims

1. A display assembly comprising a flat panel display (1) and a heater, characterised in that the heater comprises a planar heating element (20) extending across the display (1) and an edge heater (23) extending around the edge of the display.
2. A display assembly according to Claim 1, characterised in that the planar heating element (20) is of a transparent resistive material.
3. A display assembly according to Claim 2, charac-

terised in that the planar heating element (20) is of indium-tin oxide.

4. A display assembly according to any one of the preceding claims, characterised in that the edge heater includes a resistive metal strip (23) electrically insulated from the planar heating element (20).
5. A display assembly according to any one of the preceding claims, characterised in that the edge heater (23) is mounted in a frame (24) of a material having a low thermal conductivity.
6. A display assembly according to any one of the preceding claims, characterised in that the flat panel display is an LCD display (1).
7. A display assembly according to any one of the preceding claims, characterised in that the assembly includes a first temperature sensor (4) mounted to monitor the temperature towards the centre of the display (1) and a second temperature sensor (5) mounted to monitor the temperature towards the edge of the display (1).
8. A display assembly according to Claim 7, characterised in that the outputs of the first and second temperature sensors (4 and 5) are connected to a heater control unit (22), and that the heater control unit (22) controls the power supplied to the planar heating element (20) and the edge heater (23) such as to maintain the temperatures of the centre and edge of the display substantially equal.
9. A display assembly according to Claim 7 or 8, characterised in that the outputs of the first and second temperature sensors (4 and 5) are connected to a display driver unit, and that the display driver unit controls the power supplied to the display (1) according to display temperature.
10. A display assembly according to any one of the preceding claims, characterised in that the assembly supplies power to the heater (20, 23) when the assembly is first switched on, and that it supplies power sufficient to cause heating only while the flat panel display (1) is below its operating temperature.

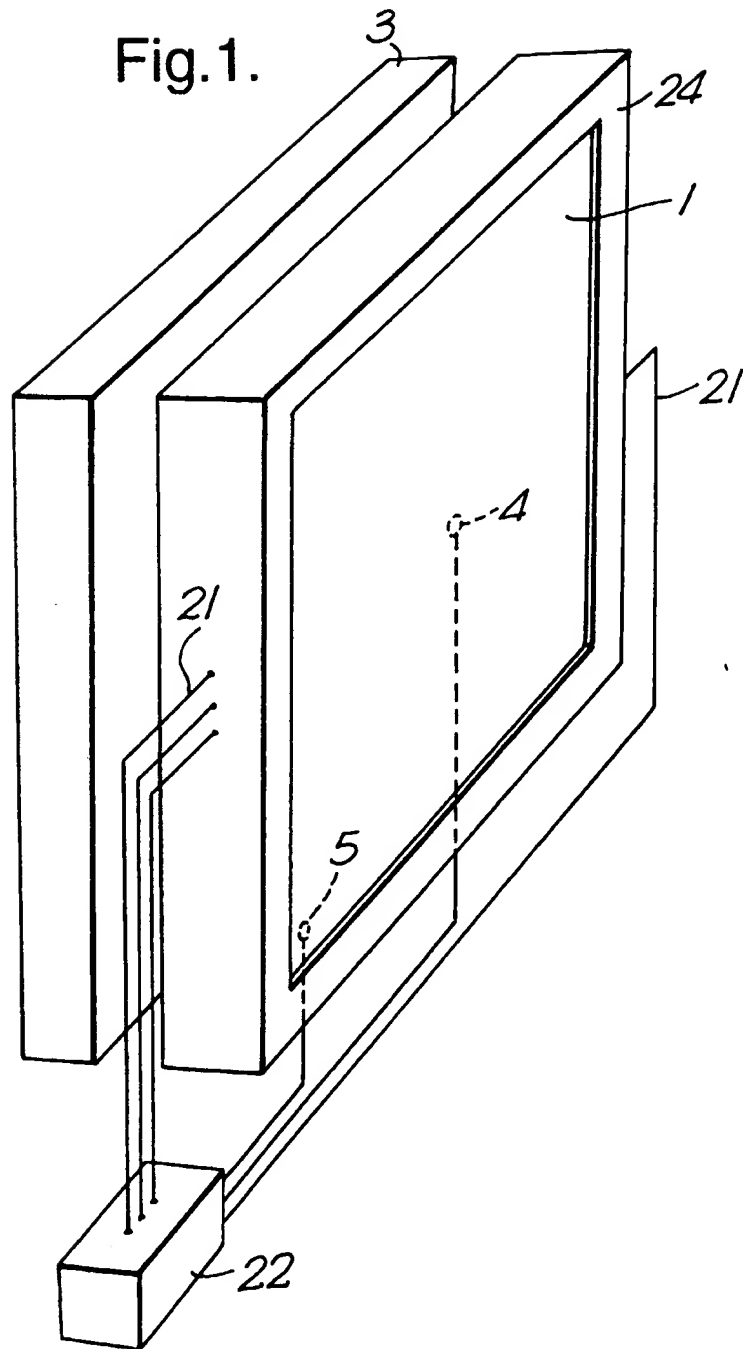


Fig.2.

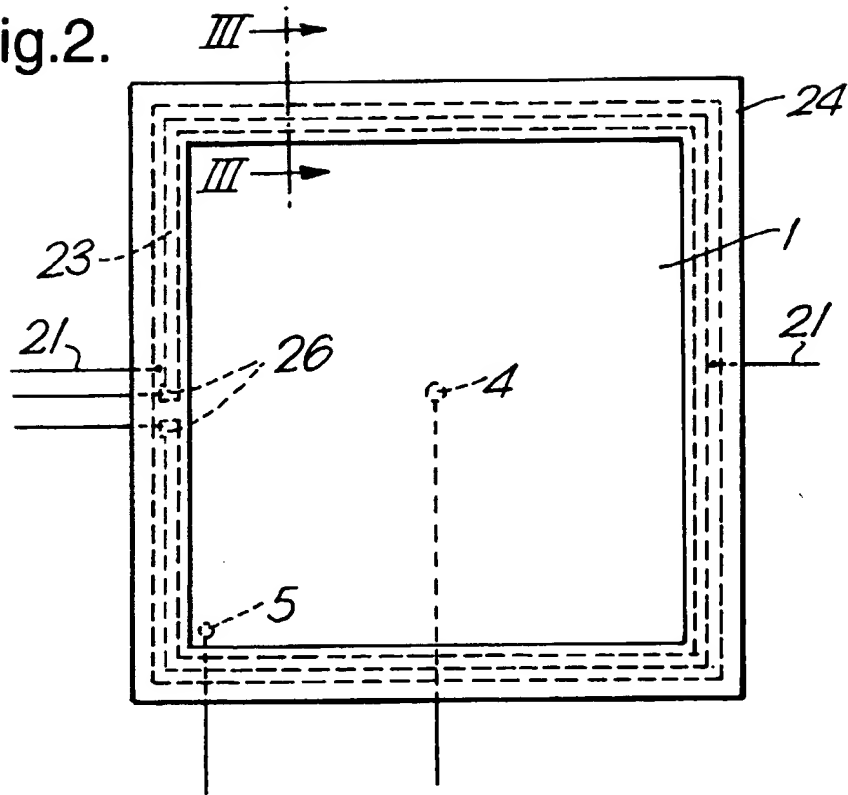
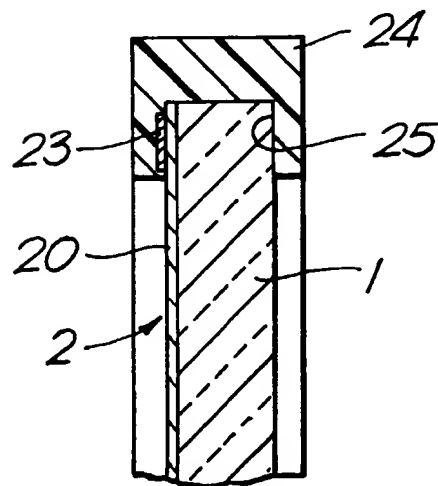


Fig.3.





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Application Number
EP 96 30 7311

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	PATENT ABSTRACTS OF JAPAN vol. 007, no. 042 (P-177), 19 February 1983 & JP 57 192927 A (SHINSHIYUU SEIKI KK), 27 November 1982, * abstract *	1,4,6,8	G02F1/133
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A	--- PATENT ABSTRACTS OF JAPAN vol. 017, no. 586 (P-1633), 26 October 1993 & JP 05 173153 A (FUJI PHOTO FILM CO LTD), 13 July 1993, * abstract *	1-4	
A	--- PATENT ABSTRACTS OF JAPAN vol. 017, no. 290 (P-1549), 3 June 1993 & JP 05 019256 A (NEC CORP), 29 January 1993, * abstract *	1,2,6	TECHNICAL FIELDS SEARCHED (Int.Cl.6) G02F
A	--- US 4 987 289 A (BISHOP GARY D ET AL) 22 January 1991 * the whole document *	1-3,6-8, 10	
A	--- EP 0 435 343 A (CANON KK) 3 July 1991 * column 17, line 31 - column 23, line 23; figures 14-20 *	1-3,5,6	

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Place of search THE HAGUE		Date of completion of the search 7 February 1997	Examiner Stang, I
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document</p>			

EPO FORM 1501 (3.9.92) (P04001)



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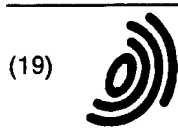
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DOCUMENTS CONSIDERED TO BE RELEVANT			
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A	EP 0 438 093 A (HONEYWELL INC) 24 July 1991 * column 3, line 12 - line 17 * * column 4, line 32 - column 5, line 21; figure 5 * -----	7-9	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
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EPO FORM 1503 01/92 (P0401)

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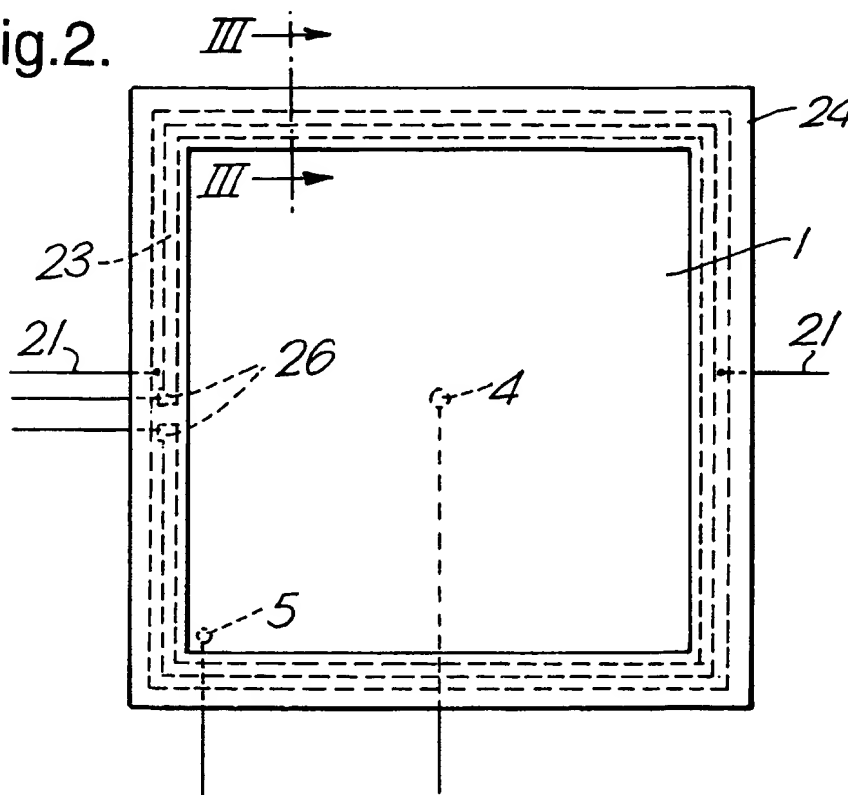
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The planar heating element is preferably of a transparent resistive material, such as indium-tin oxide. The edge heater may include a resistive metal strip electrically insulated from the planar heating element. The edge heater is preferably mounted in a frame of a material having a low thermal conductivity. The flat panel display may be an LCD display. The assembly may include a first temperature sensor mounted to monitor the temperature towards the centre of the display and a second temperature sensor mounted to monitor the temperature towards the edge of the display. The outputs

of the first and second sensors are preferably connected to a heater control unit, the heater control unit controlling the power supplied to the planar heating element and the edge heater such as to maintain the temperatures of the centre and edge of the display substantially equal. The outputs of the first and second temperature sensors may be connected to a display driver unit, the display driver unit controlling the power supplied to the display according to display temperature. The assembly may supply power to the heater when the assembly is first switched on and supply power sufficient to cause heating only while the flat panel display is below its operating temperature.

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The outputs from the sensors 4 and 5 are connected

to the heater driver 22, to control heating of the display, and to the display electronics (not shown).

When the display is started from cold, the heater driver 22 supplies power for both the thin-film layer 20 and the edge heater 23. Typically, about one quarter of the total heating load is supplied to the edge heater 23. In this way, the edge heater 23 increases the heating effect towards the edge of the display to compensate for the reduction in heating that would be produced away from the centre by the layer 20 alone. This produces substantially even heating across the entire viewing area.

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After prolonged use, the heating effect produced by the backlight 3 may be sufficient to maintain the display 1 at its operating temperature so that it is no longer necessary to supply power sufficient to cause heating to one or both heater elements 20 or 23.

Because the mechanical support for the edge of the display is provided by a thermally insulative member 24, the differential heating across the surface of the display 1 is reduced, even without the effect of the edge heater 23.

The present invention enables a greater proportion of the display area to achieve its optimum operating temperature more rapidly than has previously been possible, so that the quality of the display image is not degraded towards the edges. This is important in critical applications, such as in aircraft displays. The invention also avoids the need to apply excessive heating to the centre of the display in order to achieve correct temperature at the edges, thereby reducing the risk of damage to the display.

It will be appreciated that the edge heater could be of various different kinds and need not be a metal strip, as described.

Claims

1. A display assembly comprising a flat panel display (1) and a heater, characterised in that the heater comprises a planar heating element (20) extending across the display (1) and an edge heater (23) extending around the edge of the display.
2. A display assembly according to Claim 1, characterised in that the planar heating element (20) is of a transparent resistive material.
3. A display assembly according to Claim 2, charac-

terised in that the planar heating element (20) is of indium-tin oxide.

4. A display assembly according to any one of the preceding claims, characterised in that the edge heater includes a resistive metal strip (23) electrically insulated from the planar heating element (20).
5. A display assembly according to any one of the preceding claims, characterised in that the edge heater (23) is mounted in a frame (24) of a material having a low thermal conductivity.
6. A display assembly according to any one of the preceding claims, characterised in that the flat panel display is an LCD display (1).
7. A display assembly according to any one of the preceding claims, characterised in that the assembly includes a first temperature sensor (4) mounted to monitor the temperature towards the centre of the display (1) and a second temperature sensor (5) mounted to monitor the temperature towards the edge of the display (1).
8. A display assembly according to Claim 7, characterised in that the outputs of the first and second temperature sensors (4 and 5) are connected to a heater control unit (22), and that the heater control unit (22) controls the power supplied to the planar heating element (20) and the edge heater (23) such as to maintain the temperatures of the centre and edge of the display substantially equal.
9. A display assembly according to Claim 7 or 8, characterised in that the outputs of the first and second temperature sensors (4 and 5) are connected to a display driver unit, and that the display driver unit controls the power supplied to the display (1) according to display temperature.
10. A display assembly according to any one of the preceding claims, characterised in that the assembly supplies power to the heater (20, 23) when the assembly is first switched on, and that it supplies power sufficient to cause heating only while the flat panel display (1) is below its operating temperature.

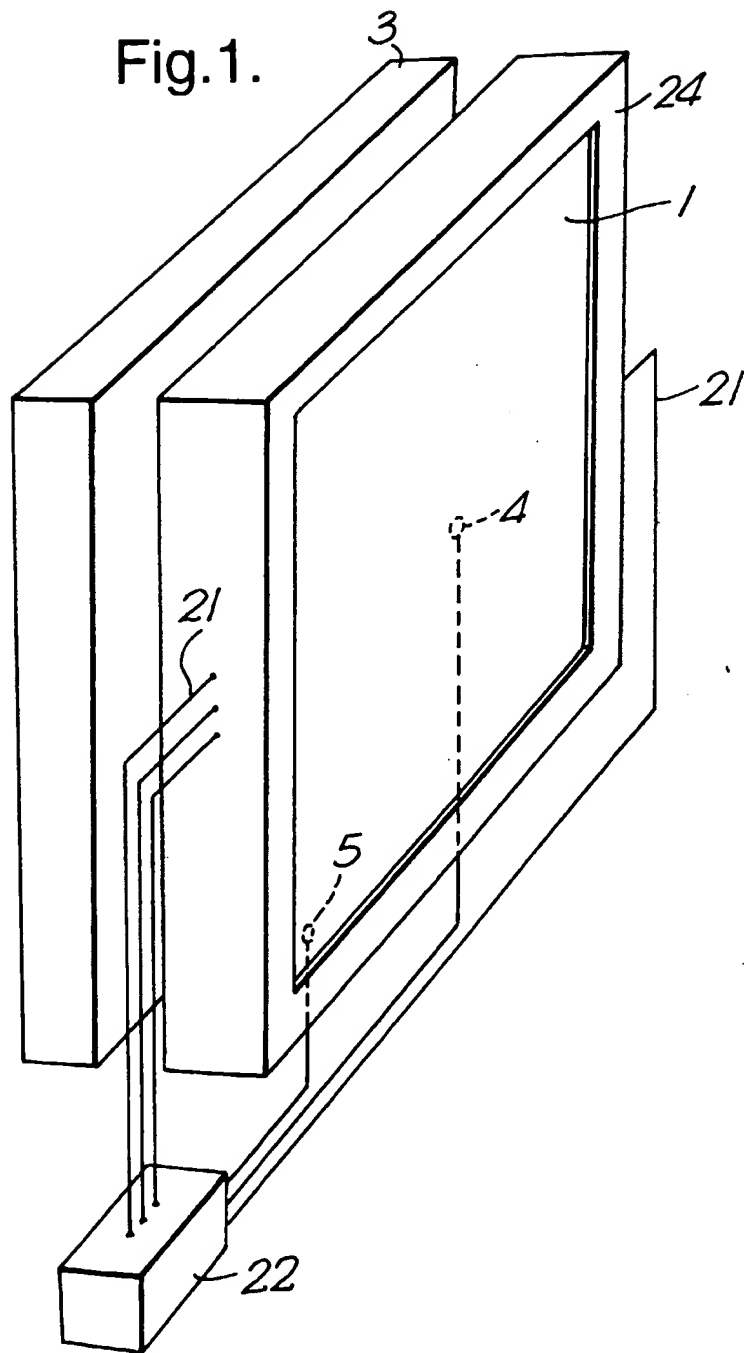


Fig.2.

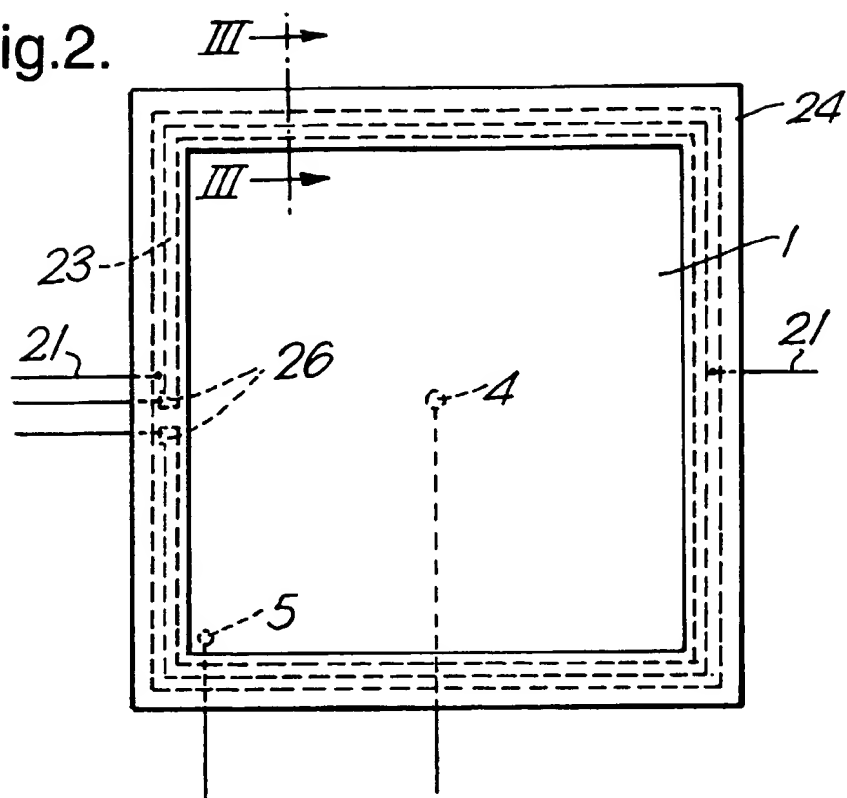
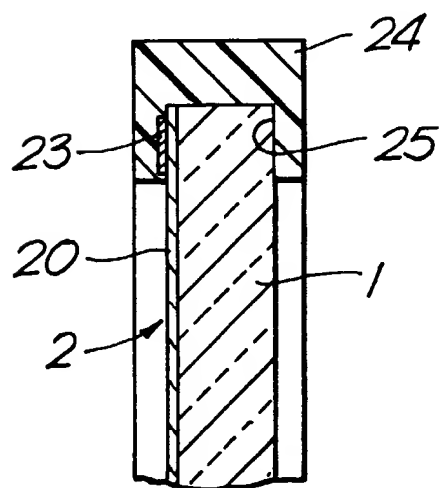


Fig.3.





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A	--- PATENT ABSTRACTS OF JAPAN vol. 017, no. 290 (P-1549), 3 June 1993 & JP 05 019256 A (NEC CORP), 29 January 1993, * abstract *	1,2,6	TECHNICAL FIELDS SEARCHED (Int.Cl.6) G02F
A	--- US 4 987 289 A (BISHOP GARY D ET AL) 22 January 1991 * the whole document *	1-3,6-8, 10	
A	--- EP 0 435 343 A (CANON KK) 3 July 1991 * column 17, line 31 - column 23, line 23; figures 14-20 *	1-3,5,6	

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The present search report has been drawn up for all claims			
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